(12) UK Patent Application (19) GB (11) 2 246 670 (13) A

(43) Date of A publication 05.02.1992

(21) Application No 9017022.6

(22) Date of filing 03.08.1990

(51) INT CL[5]
H01P 1/203

(52) UK CL (Edition K)
H1W WBA W3B W3X W7

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(58) Field of search
UK CL (Edition K) H1W WBA
INT CL[5] H01P

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(54) Microstrip filter

(57) A combination of microstrip resonators and reactive elements is used in parallel coupled lines filter structures to improve the performance of these filters at the upper stop band and move the first harmonic band well away from the centre frequency and put it where the designer desires. Reactive components or an active/passive circuit equivalent to reactance at the working frequency are coupled between ground and the resonator line ends. These components may be capacitive or inductive, or microstrip stub lines.

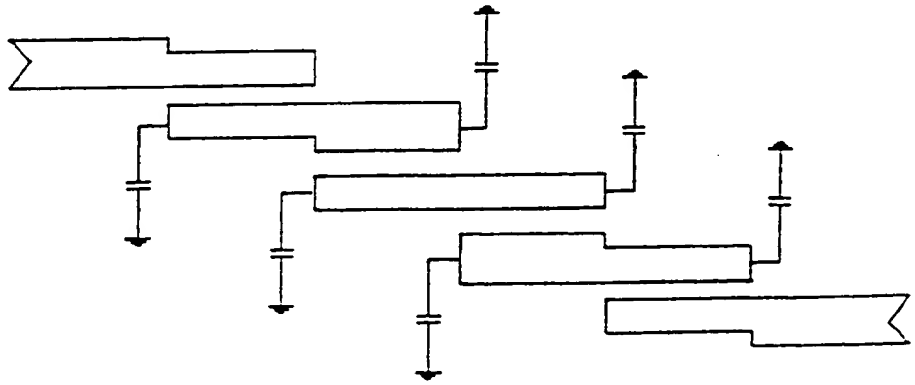

Fig. 3 Novel filter

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The claims were filed later than the filing date within the period prescribed by Rule 25(1) of the Patents Rules 1990.

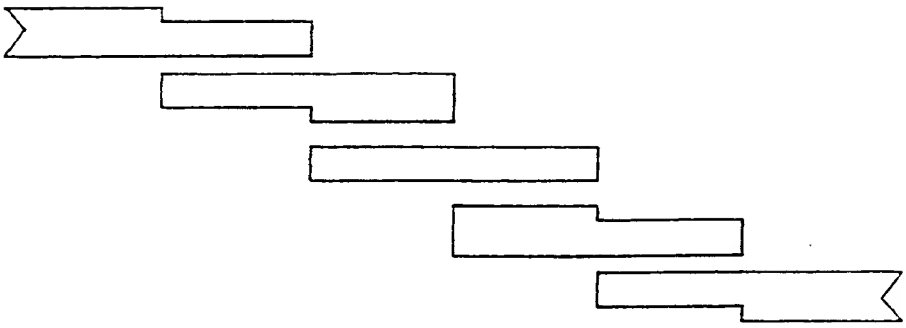

Fig. 1 Conventional filter

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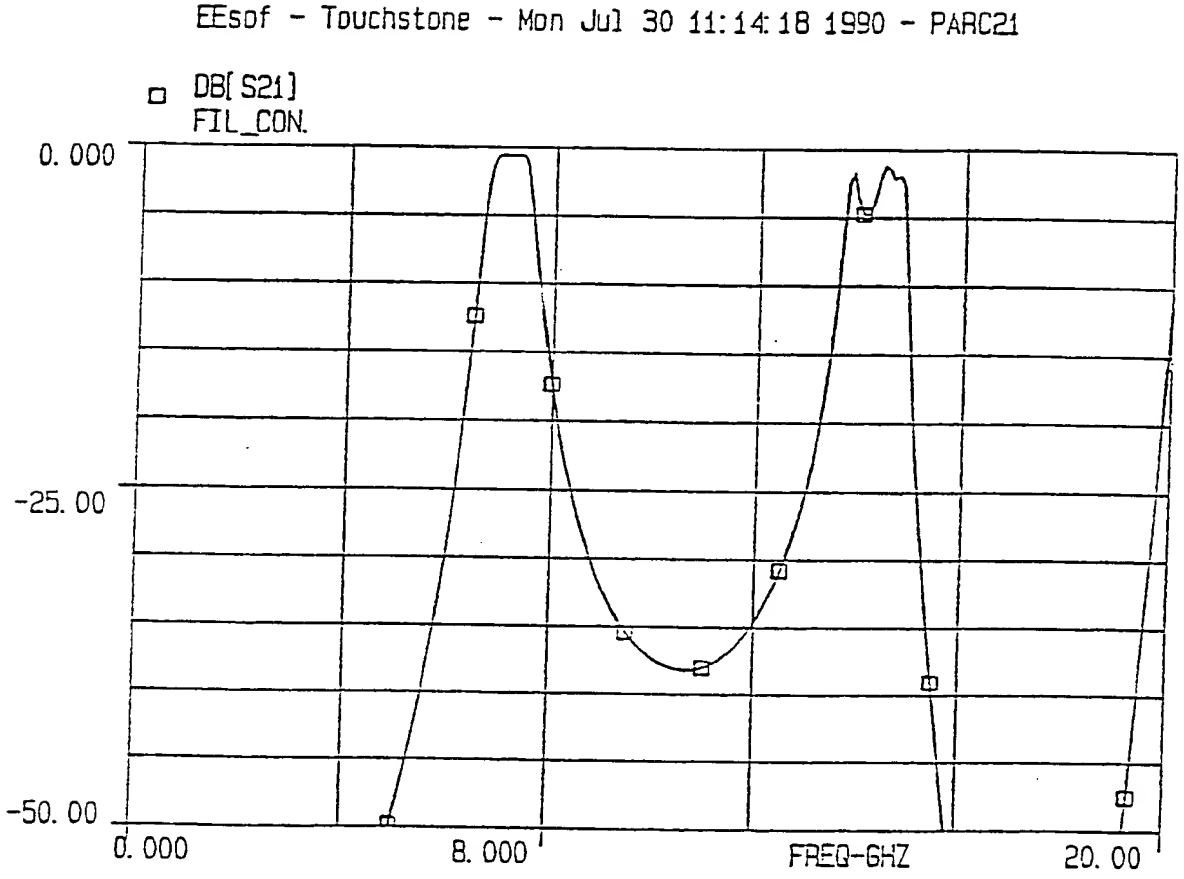

Fig. 2 A typical insertion loss of a conventional filter

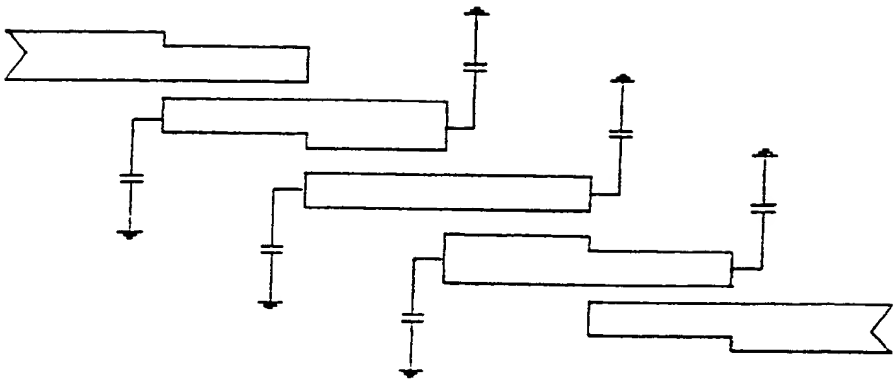

Fig. 3 Novel filter

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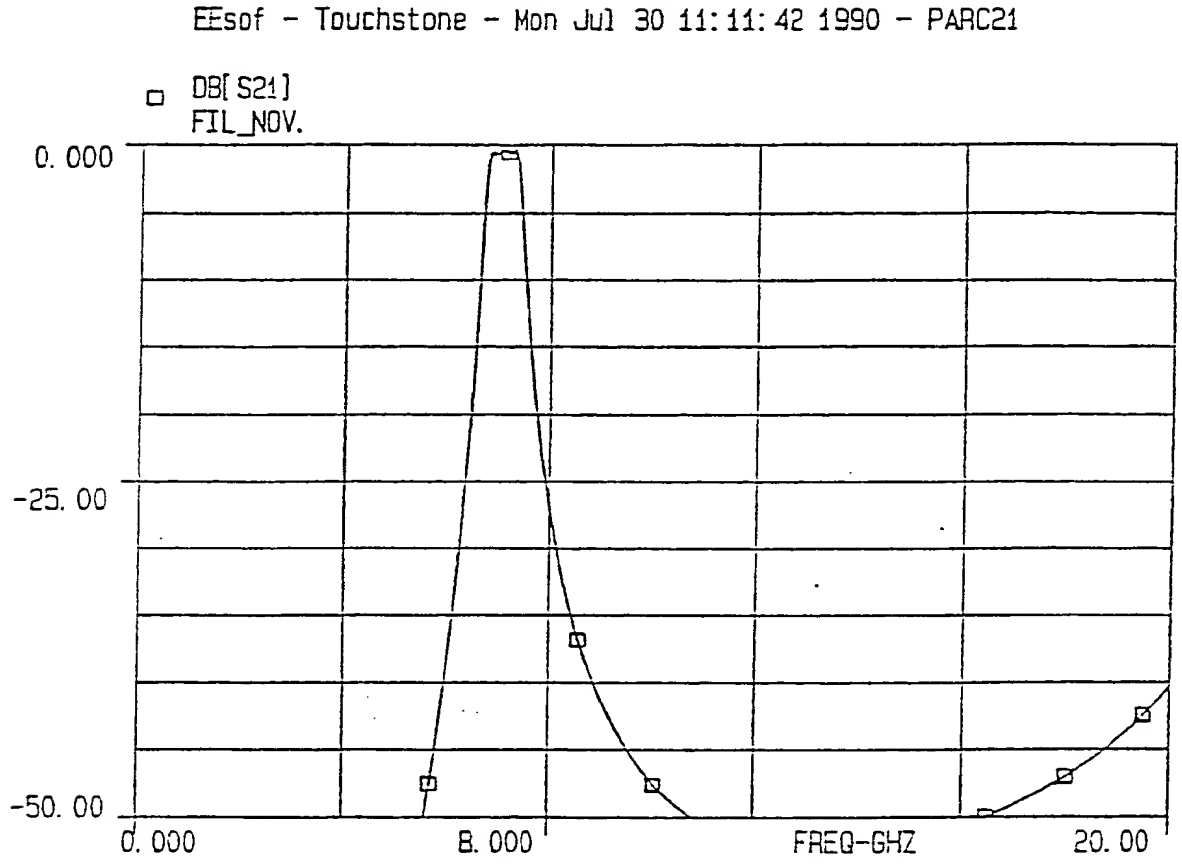

Fig. 4 A typical insertion loss of the novel filter

Microstrip Coupled lines Filters with Improved performance

This invention relates to Microstrip Parallel Coupled lines Filters.

Parallel coupled lines filters are extensively used as bandpass filters because of their compact size, easy design and implementation.

However there are several problems with these filters especially when implemented in microstrip. Firstly, apart from their main pass bands, they also have got harmonic bands. The centre frequency of these spurious bands are at an integer multiple of their main bands. First harmonic band at twice the centre frequency results in poor second harmonic suppression when used as output filters in oscillators and amplifiers and the like. Secondly, since in microstrip, the dielectric medium is not homogenous a part of the odd-mode field extends into the air above the substrate between the conductors. Consequently, the effective dielectric constants are not equal for the two modes. This inequality results in different phase velocities for the two modes. Because the physical length of each coupled section in a parallel cou-

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pled filter is the same for both even and odd modes, the unequal phase velocities of these modes create different half wavelength frequencies for these modes and this manifests itself as asymmetric passband response and deterioration of the upper stopband performance. In addition it moves the second passband (which is at about twice the center frequency) toward the centre frequency. Often this poor stopband rejection forces the microwave designer to employ a lowpass filter preceding the bandpass filter in subsystems.

The present invention not only improves the stop band performance of the parallel coupled lines filters but also moves their second passband further away from the desired pass band. The place of first spurious harmonic- band is then in the hand of the designer.

A specific embodiment of the invention will now be described by way of example with reference to the accompanying drawings in which:

Figure 1 shows conventional microstrip parallel coupled lines filter.

Figure 2 shows a typical insetion loss of a conventional filter.

Figure 3 shows the new invention in which the lumped capacitors are used as the reactive elements.

Figure 4 shows a typical insertion loss of a filter with the same number of pairs of parallel coupled lines as figure 1 but the new invention is used to improve the performance and shift the first harmonic well away from the centre frequency.

Referring to the drawings, a parallel coupled lines microstrip filter comprises several parallel strips of lines. The number and the dimensions of these strips are related to the desired performance of the filter and the specification of the substrate.

As figure 2 shows, the performance of a filter of this kind is deteriorated because second harmonic band has shifted toward centre frequency (this harmonic should have occured at twice of the centre frequency).

In the present invention one or several reactive elements (lumped or distributed capacitors and/or, lumped or distributed inductors and/or, a combination of passive and active elements which behaves

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as a reactive element over a range of frequency) are connected at one or both ends of one or several resonators (strips) and ground. The values of these reactive elements depend on the desired centre frequency of the first harmonic band. The overall physical length of each resonator plus the equivalent length of the reactive elements connected to it should be equal to a half wave-length at the centre frequency. Figure 3 shows an example of this invention in which the lumped capacitors are used as the reactive elements.

Figure 4 shows a typical response for the filter of Figure 3.

Claims

1- A new parallel coupled lines microstrip filter structure in which one or several lumped or distributed capacitors are connected to one or both ends of one or several resonators and ground.

2- A new parallel coupled lines microstrip filter structure in which one or several lumped or distributed inductors are connected to one or both ends of one or several resonators and ground.

3- A new parallel coupled lines microstrip filter structure in which one or several microstrip stubs are connected to one or both ends of one or several resonators and ground.

4- A new parallel coupled lines microstrip filter structure in which one or several combinations of passive and active elements which behaves as a reactive element over a range of frequency are connected to one or both ends of one or several resonators and ground.

5- A new parallel coupled lines microstrip filter structure in which one or several reactive elements (lumped or distributed capacitors and/or lumped or distributed inductors and/or microstrip stubs and/or a combination of passive and active elements which behaves as a reactive element over a range of frequency) are connected to one or both ends of one or several resonators and ground.

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Amendments to the claims
have been filed as follows

1- A new parallel coupled line microstrip filter structure in which one or several lumped or distributed inductors are connected to one or both ends of one or several resonators and ground.

2- A new parallel coupled line microstrip filter structure in which one or several microstrip stubs are connected to one or both ends of one or several resonators and ground.

3- A new parallel coupled line microstrip filter structure in which one or several combinations of passive and active elements which behaves like an reactive element over a range of frequency, are connected to one or both ends of one or several resonators and ground.

4- A new parallel coupled line microstrip filter structure in which one or several reactive elements, Lumped or distributed inductors and/or microstrip stubs and/or a combination of passive and active elements which behaves like an reactive element over a range of frequency, are connected to one or both ends of one or several resonators and ground.

Published 1992 at The Patent Office, Concept House, Cardiff Road, Newport, Gwent NP9 1RH. Further copies may be obtained from:
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